SHESTOPALOV, V.P.

4

Sestopalov, V. P. General solution of the problem of the temperature boundary layer in a diffusor. Izv. Akad. Nauk SSSR. Otd. Tehn. Nauk 1956, no. 8, 3–9. (Russian)

The author investigates temperature distribution in a boundary layer along one wall of a diffusor. He considers two-dimensional convergent laminar flow of a viscous non-compressible liquid between two inclined walls. In Prikl. Mat. Meh. 16 (1952), 613–616 [MR 14, 697], the author found a particular integral of the non-homogeneous differential equation controlling the phenomenon; in this work he finds the complementary function, that is the solution of the homogeneous part of the above equation, together with the previously found particular integral gives the general solution. By suitable substitutions and changes of variables the author reduces the thermal equation into an ordinary hypergeometric differential equation obtaining a solution which contains, of course, hypergeometric functions. The solution enables the author to find an approximate expression for the heat transfer coefficient (the Nusselt number). *T. Leser.*

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Abst. 1076151

SOV/124-57-8-9038

Translation from: Referativnyy zhurnal, Mekhanika, 1957, Nr 8, p 66 (USSR)

AUTHOR: Shestopalov, V. P.

TITLE: The Laminar Flow Past a Plate in the Nonlinear Theory of the Boundary Layer of a Viscous, Compressible Fluid With an Arbitrary Temperature Distribution Along the Surface (Laminarnoye obtekaniye plastinki v nelineynoy teorii pogranichnogo sloya vyazkoy szhimayemoy zhidkosti pri proizvol'nom raspredelenii temperatury vdol' poverkhnosti)

PERIODICAL: Uch. zap. Khar'kovsk. gos. ped. in-ta, 1956, Vol 18, pp 121-133

ABSTRACT: The author assumes a nonlinear temperature dependence of the viscosity coefficient, in consequence whereof he inserts into the equation of motion an additional term with a new viscosity coefficient which is proportional to T^2 (where T is the temperature). Thereupon the solution of the system of boundary-layer equations is performed by means of the method of Chapman and Rubesin (Mekhanika. Sb. perev. i obz. in. period. lit., 1950, Nr 4) under the same premises. The article points out that for high flow Mach numbers the thermal boundary layer is considerably thicker than those computed by Chapman and

Card 1/2

SHESTOPALOV, V.P. [redacted]

PA - 1831

CARD 1 / 2

SUBJECT USSR / PHYSICS

AUTHOR ŠESTOPALOV, V.P.

TITLE The Propagation of Electromagnetic Waves along a Wave Conductor with a Spiral which is Partly Filled with a Dielectricum.

PERIODICAL Žurn.techn.fis, 26, fasc.12, 2749-2754 (1956)
Issued: 1 / 1957

By a wave conductor with spiral which is partly filled with a dielectricum one understands a system which consists of a wire spiral with round cross section and a winding angle Ψ. This spiral is arranged coaxially in a metal tube having a radius r_3 the inner walls of which are covered by a dielectricum layer of a certain thickness r_3-r_2. r_2 denotes the distance between the axis of the system and the dielectricum layer. The present work investigates the case in which the electrons are able to move within the spiral only in the direction of the axis of the wave conductor and form a monoenergetic bundle with round cross section and the radius $a(0\leqslant r\leqslant a)$. Equations are set up for the following domains: $0\leqslant r\leqslant a$, $a\leqslant r\leqslant r_1$ (r_1 is the radius of the spiral), $r_1\leqslant r\leqslant r_2$, $r_2\leqslant r\leqslant r_3$. The boundary conditions are formulated: 1. On the boundary of the electron bundle at $r=a$, 2. On the spiral at $r=r_1$, 3. On the boundary of the second and third domain at $r=r_2$, and 4. On the outer conductor (shell) at $r=r_3$. On the assumption that the conditions

PA - 1831

APPROVED FOR RELEASE: 07/13/2001 CIA-RDP86-00513R001549130006-2

Žurn.techn.fis, 26, fasc.12, 2749-2754 (1956) CARD 2 / 2

of the small amplitudes are satisfied, the equation for the motion of the electrons and the equation for saturation are written down. Two equations are obtained with the help of which the quantities β and γ (β - a constant and γ - the propagation constant) can be found. From the same equations all radicals of the system are obtained, which are known to be difficult to find in the general form. It is therefore necessary to be content with an approximative investigation of these equations for the most simple case. Analysis is carried out for weak electron bundles at an initial velocity of electrons that is a near approach to that of no-fluctuating waves. Besides, the case of sufficiently high frequencies, for which the arguments of the BESSEL function in the equation which was set up, will suffice, is investigated. In contrast to the wave conductor with spiral in the work by LOSAKOV, Zurn.techn.fis 19, 678 (1949), the dielectricum layer in this case exercises an important influence on the propagation character of the electromagnetic waves.

INSTITUTION:

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S/124/60/000/006/014/039
A005/A001

The Application of Integral Correlations to the Solution of the Problem of the Flow Around a Plate

The tension from the friction at the plate is determined in the nonlinear theory of the boundary layer as follows:

$$p_{xy}\Big|_{y=0} = \rho\nu\left(\frac{\partial u}{\partial y}\right)_{y=0} \qquad (3)$$

In the present case is:

$$p_{xy}\Big|_{y=0} = \rho\nu\,\frac{V\pi}{2\,\delta(x)} \qquad (4)$$

Having integrated Eq. (1) over x we obtain:

$$-\frac{\nu x}{V} = \frac{\pi-4}{\pi^2}\,\delta^2(x) + \frac{l+\pi}{4}\ln\delta(x) + C\,.$$

The constant C is determined from the experimental data. The numerical calculation of the tension of friction at the two-dimensional plate is exemplified. A comparison with the experimental results shows that the correlation obtained from the nonlinear theory satisfactorily agrees with the experience. There are 6 references.

Ye.N. Bondarev

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

1..-1-15/13

AUTHOR: Shestopalov, V.P.

TITLE: Electron Beam in the Helix Situated in a Dielectric Medium. (Elektronnyy puchok v spirali, pomeshchennoy v dielektricheskuyu sredu)

PERIODICAL: Radiotekhnika i Elektronika, 195., Vol.III, Nr 1, pp.131-141 (USSR)

ABSTRACT: The system considered consists of a helical spiral having a winding angle ϕ and a circular cross-section with a radius r_1, which is situated in a dielectric cylinder, having a radius r_2 (see Fig.1). It is assumed that the electrons in the helix move in the direction of the main axis and the electron beam has a radius a. The electron beam has a density $\rho = \rho_0 + \rho'$ and has a velocity $\vec{v} = \vec{v}_0 + \vec{v}^1$, where ρ_0 and $\vec{v}_0$ are the density and the velocity in the steady state (DC conditions). It is further assumed that the deviation from the steady state is comparatively small. For the purpose of analysis the system is divided into 4 regions: I - the region inside the electron beam is $0 \leq r \leq a$; II - the region between the beam and the helix, $a \leq r \leq r_1$; III - region between the helix

Card 1/4

Electron Beam in the Helix Situated in a Dielectric Medium

and the dielectric, $r_1 \leq r \leq r_2$; and IV - region inside the dielectric, $r_2 \leq r \leq \infty$. Permittivity in the first 3 regions is ε and it is ε_1 in the region IV. Permeability is μ for all the regions. It is shown that the Maxwell equations for the region I, when expressed in a cylindrical coordinate system r, φ, z are in the form of Eqs.(2) and for the regions II, III and IV they are given by Eqs.(3). The electron motion equation leads to Eqs.(4) for ρ', v' and j' (where j' is the current component). Solutions of the wave equations for the z-components in the four regions are given by Eqs.(6), (7), (8) and (9) respectively, where the quantities Γ, γ and γ_1 are defined by Eqs.(10) and $\omega_e^2 = \frac{\rho_0 e}{m\varepsilon}$, while I_0, K_0 are modified Bessel functions of the first and second kind of the zero order. Similarly, the radial and angular components of the electromagnetic fields for the four regions are expressed by Eqs. (11), (12) and (13). The fields have to fulfil the boundary

Card 2/4

conditions expressed by Eqs.(14-18). If the boundary conditions are substituted into the expressions for the electromagnetic fields, a system of linear algebraic equations is obtained from which it follows that the various constants of the equations can be expressed as shown by Eqs.(19) on p.135. All the integration constants in Eq.(19) can be expressed in terms of A_1, where A_1 is determined by the amplitude of the applied field. By substituting the necessary constants into Eq.(17) the dispersion formula for the system is in the form of Eq.(20) where φ is given by Eq.(21). Eq.(20) can be used to find the unknown propagation constant β for a given set of values of a, r_1, r_2, ψ, ε_o and ε_1. Unfortunately, the dispersion equation cannot be solved directly but it can be simplified if it is assumed that $r_1 = r_2$. In this case it can be written as Eq.(26). The results are shown graphically in Fig.2 and Figs.3. From the above it is concluded that with increasing $\varepsilon_1/\varepsilon_o$ the amplification of the system becomes reduced but the efficiency changes only insignificantly;

109-1-15/18

Electron Beam in the Helix Situated in a Dielectric Medium

this occurs at the average electron velocities where the amplification is still possible. There are 3 figures, and 9 references, 5 of which are Russian and 4 English.

SUBMITTED: October 14, 1956

AVAILABLE: Library of Congress

Card 4/4

57-1-26/30

AUTHORS: Bulgakov, B. M., Shestopalov, V. P.,

TITLE: Propagation of Electro-Magnetic Waves in Retarding Systems, Using a Spiral and a Dielectric (Rasprostraneniye elektromagnitnykh voln v zamedlyayushchikh sistemakh, ispol'zuyushchikh spiral' i dielektrik)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 1, pp. 188-201 (USSR)

ABSTRACT: The propagation of electromagnetic waves is investigated in a spiral located in a dielectric medium at the presence of an electron bundle. The properties of retarding systems in which construction changes in the spiral as well as in the dielectric are poss-ible, are investigated. It is demonstrated: 1) The amplification of the system at constant wave length decreases somewhat with the increase of the dielectricity constant of the medium in which the spiral is located, i.e. in the case of a certain increase of the velocity interval of the electron bundle for which an amplification isstill possible. The efficiency of the system changes unimportantly. 2) The amplification coefficient of the system electron bundle -spiral-dielectric - can be higher than the amplification coefficient of electron bundle - spiral if the wave length of the intensified oscillations is specially chosen i.e.

Card 1/2

Propagation of Electron-Magnetic Waves in Retarding Systems, Using 57-1-26/30
a Spiral and a Dielectric.

$$\frac{c}{v_{phase}} \quad \frac{2\pi}{\lambda_0} r_1 = \text{const.}$$

r_1 - radius of the spiral, v_{phase} - phase velocity, λ_0 - wave length, c - light velocity. 3) The introduction of additional elements into the retarding systems (axial metal bar, exterior metal housing etc.) makes possible change dispersion dependence of the system. 4) The use of magnetic-cans (magnetik) in retarding systems along with dielectrics leads to an important new distribution of the electromagnetic energy flow propagating in the system.

ASSOCIATION: Khar'kov State University imeni A.M. Gor'kiy (Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo)

SUBMITTED: November 20, 1956

AVAILABLE: Library of Congress

Card 2/2

The Investigation of a Moderating System With 2 Spirals in a Dielectric Medium 57-28-6-26/34

employ such a method of moderation in the electron apparatus. It is necessary to study a moderating system in which both a spiral and a dielectric is used, and in which the energy current is nearly uniformly distributed inside and outside the spiral. As a possible solution of this problem the author suggests using 2 spirals. In this case one of the spirals is located in the free space and the other in a dielectric extending without limits in radial direction. The presence of a second spiral makes it possible to modify the structure of the electromagnetic field in the system considerably. This also leads to the new distribution of the "propagated" capacity. Investigation of the moderating systems with spirals surrounded by the dielectric medium appears to be necessary also from other points of view. It is known that the spirals in the case of the usual type of travelling wave tubes are supported either by a glass tube or by means of a special type of dielectric rod. Therefore determination of e.g. the resistance must be carried out by taking the dielectric content of the tube into account (Reference 6 and 7). The analysis carried out shows

Card 2/4

The Investigation of a Moderating System With 2 Spirals in a Dielectric Medium 57-28-6-26/34

that the use of 2 spirals in the dielectric medium in the case of a suitable selection of the winding angles and the dielectric permeability values offers the following possibilities: 1) The dispersion of the system can be modified within wide limits. 2) A new distribution of the energy current in the system, which is more profitable for practical purposes, can be carried out. 3) The resistance in the system can be reduced. Therefore, the increase of the dielectric permeability values ε_2 of the medium, in which the 2. spiral is located, seems to be one of the possible means of improving the efficiency of the traveling wave tube. As is shown by calculations (figure 5) the dielectric may in this case directly adjoin the 1. and 2. spiral. There are 8 figures and 8 references, 5 of which are Soviet.

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet (Khar'kov State University)

Card 3/4

The Investigation of a Moderating System With 2 Spirals 57-28-6-26/34
in a Dielectric Medium

SUBMITTED: April 17, 1957

1. Waves--Velocity 2. Dielectrics--Performance 3. Magnetic fields--Performance 4. Traveling wave tubes--Performance 5. Mathematics

Card 4/4

for convergent flow of the liquid ($Q < 0$), and a similarity with the derivations of the heat transfer calculations is noted, and a comparison with autocatalytic reactions is made. After a complete mathematical derivation, the final formula, is given as a first approximation for the concentration distribution of the convective diffusion, whereas the calculation formula for the thickness of the boundary diffusion layer is given by using the approximation equation for the diffusion current according to the Nernst theory (ref 3). From the obtained results, it follows that the diffusion current decreases with an increase in the distance to the outlet of the diffuser, whereas the thickness of the boundary diffusion layer increases. The latter is inversely proportional to the square root of the potential motion of the liquid in the diffuser, as shown by the formula. Some earlier observations are confirmed by the present observations. There are 5 references, 4 of which are Soviet.

Shestopalov, V. P.

В. В. Сестрорецкий,
А. А. Романов

Исследование диапазонных свойств Ш-волновода

11 июня

(с 18 до 22 часов)

Н. А. Хуторов

Скалярные потенциальные функции уравнений электродинамики в неортогональной криволинейной системе координат, метрика которых не зависит от одной координаты

Н. П. Керженцева

Оптимальная форма изгиба волновода в условиях многоволновости

Ю. М. Исаенко

Теоретическое исследование щелевого возбудителя волны H в волноводе круглого сечения

Р. Б. Ваганов

Экспериментальный анализ электромагнитного поля вблизи волноводных переходов, содержащих критическое сечение

В. П. Шестопалов

Дисперсионные свойства и пространственный резонанс спирального волновода, помещенного в магнитодиэлектрическую среду

3. СЕКЦИЯ ПОЛУПРОВОДНИКОВЫХ ПРИБОРОВ

Руководитель Е. И. Гальперин

9 июня

(с 10 до 16 часов)

А. А. Маслов

Новые полупроводниковые приборы для радиоэлектронной аппаратуры

Р. Е. Смолянский,
М. И. Лукачевич

Новый полупроводниковый прибор на базе кремния — аналог тиратрона

Т. М. Агаханян,
Л. Н. Патрикеев

Работа дрейфового транзистора при большом сигнале

Ю. Е. Беркутов

Переходный процесс запирания германиевых плоскостных диодов при больших токах

9 июня

(с 18 до 22 часов)

report submitted for the Centennial Meeting of the Scientific Technological Society of Radio Engineering and Electrical Communications im. A. S. Popov (VNORiE), Moscow, 8-12 June. 1959

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A001/A001

Propagation of Electromagnetic Waves in Decelerating Systems Which Contain a Spiral and a Dielectric

shown that the amplification factor of such a system can be larger than the amplification factor of the spiral - electron beam system, if the wavelength of amplified oscillations is chosen in a special way and satisfies the following relation:

$$\frac{c}{v_{ph}} \cdot \frac{2\pi}{\lambda_0} a = \text{const},$$

where c and λ_0 are light velocity and wavelength in free space, v_{ph} is the phase velocity of the decelerated wave, and a is spiral radius. Possible changes in the design of the spiral - dielectric system are considered. It was established that the introduction of additional elements into the decelerating system (axial metal rod, external metal casing, etc) permits changes in the nature of dispersion characteristics of the system. The authors performed also an analysis of the system consisting of a spiral and a magneto-dielectric. The use in decelerating systems of magnetics, side-by-side with dielectrics, leads to a considerable re-distribution of the flux of electromagnetic energy which propagates in the system. There are 9 references.

V.P. Shestopalov

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

67477

SOV/24-59-4-21/33

Influence of the Magneto-dielectric Medium on the Propagation of Electromagnetic Waves in a Helical Waveguide Situated in a Magneto-dielectric

the longitudinal coordinate z is in the form of $\exp[i(\omega t - \beta z)]$, where ω is the angular frequency and β is the longitudinal propagation constant. The expressions for the normalised field components are:

$$e_r = \frac{E_r}{E_z} = \beta r \xi_1(x) \frac{1 - \delta\sigma_1(x)}{1 - \delta\sigma_0(x)}, \quad e_\varphi = \frac{E_\varphi}{H_z} = -\omega\mu r \xi_1(x) \frac{1 - \theta\sigma_1(x)}{1 + \theta\sigma_0(x)}$$

$$h_r = \frac{H_r}{H_z} = \beta r \xi_1(x) \frac{1 - \theta\sigma_1(x)}{1 + \theta\sigma_0(x)}, \quad h_\varphi = \frac{H_\varphi}{E_z} \omega\varepsilon r \xi_1(x) \frac{1 - \delta\sigma_1(x)}{1 + \delta\sigma_0(x)} \qquad (1.1)$$

where δ and θ are unknown integration constants which can be defined from the boundary conditions. Other parameters of Eqs (1.1) are defined by Eqs (1.2), where

4

Card 2/8

67477

SOV/24-59-4-21/33

Influence of the Magneto-dielectric Medium on the Propagation of Electromagnetic Waves in a Helical Waveguide Situated in a Magneto-dielectric

where A and B are defined by Eqs (1.5). The symbol ψ in the above equations denotes the winding angle of the helix. In the symbols σ_{nml} and ξ_{nml}, the first subcript denotes the order of the functions in Eqs (1.2), the second subscript refers to the medium, while the third subscript denotes the radius of the helix or the radius of the magneto-dielectric. The constants δ_1 and θ_1, which define the relative field components in the space between the helix and the magneto-dielectric, and δ_2 and θ_2, which refer to the inside of the magneto-dielectric tube, are expressed by Eqs (1.6). Eq (1.4) determines the relationship between the transverse propagation constants for vacuum γ_0 and for magneto-dielectric γ_1; These quantities are related by Eqs (1.7).

4

Card 4/8

67477

SOV/24-59-4-21/33

Influence of the Magneto-dielectric Medium on the Propagation of Electromagnetic Waves in a Helical Waveguide Situated in a Magneto-dielectric

results obtained on the basis of Eq (1.9) are shown in Figures 3-7. Figure 3 illustrates the dependence of $(c/v_{\Phi})\mathrm{tg}\Psi$ on the ratio of the radius of the magneto-dielectric to the radius of the helix. The values of c/v_{Φ} as a function of βr_1 are plotted in Figures 4 and 5 for various values of ε and μ. Similar curves are shown in Figure 6. Figure 7 illustrates the solution of Eq (1.9) for special cases. Further calculated results are given in Figure 8, which shows the ratio of the power propagating inside the helix to the power outside it as a function βr_1. When the helix is closely adjacent to the magneto-dielectric, the boundary conditions of the system can be expressed by Eqs (3.1) (Refs 16, 17). The notation adopted in these equations is defined by Eq (3.2), where l is the width of the tape of the helix and d is its spacing. For this system, the dispersion 4

Card 6/8

67477

SOV/24-59-4-21/33

Influence of the Magneto-dielectric Medium on the Propagation of Electromagnetic Waves in a Helical Waveguide Situated in a Magneto-dielectric

delay systems or matching sections), antennae, measurement of permittivity and permeability of various materials and long-distance transmission waveguides.
There are 10 figures and 22 references, of which 5 are English, 17 Soviet; 1 of the Soviet references is translated from English.

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet (Khar'kov State University)

SUBMITTED: April 9, 1959

Card 8/8

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S/112/60/000/008/010/012

ED FOR RELEASE: 07/13/2001 CIA-RDP86-00513R001549130006-

9,1300

Translation from: Referativnyy zhurnal. Elektrotekhnika, 1960, No. 8, p. 411, # 6.7166

AUTHORS: Khizhnyak, N.A., Shestopalov, V.P.

TITLE: Characteristics of the Vavilov - Cherenkov Effect in Anisotropic Waveguides

PERIODICAL: Uch. zap. Khar'kovsk. un-t, 1959, Vol. 102, Tr. Radiofiz. fak. Vol. 3, pp. 69-74

TEXT: The authors analyze the losses of energy of particles which move uniformly along the axis of rectangular waveguides loaded by a homogeneous and anisotropic dielectric with a diagonal tensor of the specific inductive capacitance. Expressions for the radiation field were obtained. It is shown that, unlike in the case of particles moving in an unrestricted medium, the fields of ordinary and extraordinary waves are connected among each other by boundary conditions which produce an oscillation system similar to the sympathetic pendulum. Owing to the coherence of ordinary and extraordinary waves, a beat is produced. It

Card 1/2

Card 2/2

SOV/109- - -4-3-34/38

AUTHORS: Shestopalov, V.P., and Yatsuk, K.P.

TITLE: Applications of Slow Surface Waves for the Measurement of the Permittivities of Materials at Ultrahigh Frequencies (Ispol'zovaniye medlennykh poverkhnostnykh voln dlya izmereniya dielektricheskikh pronitsayemostey veshchestva na sverkhvysokikh chastotakh)

PERIODICAL: Radiotekhnika i Elektronika, Vol 4, Nr 3, 1959, pp 547-549 (USSR)

ABSTRACT: It is known (Ref 1) that a helix having a radius a and a winding angle has the scattering equation in the form:

$$\frac{k^2}{k_1^2} \operatorname{ctg}^2 \Psi = \frac{I_0(k_1 a)\, K_0(k_1 a)}{I_1(k_1 a)\, K_1(k_1 a)} , \qquad (1)$$

where $k = \frac{\omega}{c} = \frac{2\pi}{\lambda_0}$; $k_1^2 = k_3^2 - k^2$; $k_3 = \frac{\omega}{v_\Phi} = \frac{2\pi}{\lambda_g}$;

where λ_0 is the wavelength in free space, λ_g is the length of the wave slowed-down by the helix, ω is the frequency of the generator and v_Φ is the phase velocity of the wave in the helix. If the helix contains a dielectric rod of a radius a, the scattering equation

Card 1/3

Applications of Slow Surface Waves for the Measurement of the Permittivities of Materials at Ultrahigh Frequencies

can be written as Eq (2). On the basis of Eqs (1) and (2) it is possible to find the value of the permittivity of the rod and this is approximately given by:

$$\varepsilon \approx 2\left(\frac{\lambda_g}{\lambda'_g}\right)^2 - 1 \qquad (4)$$

If there is a clearance between the rod and the helix, the expression for ε is given by Eq (5), where b is the radius of the rod; λ'_g is the length of the wave slowed-down by the helix and the rod. If the helix is such that the radius of its conductor is small in comparison with its period, the expression for ε is given by Eq (6) where d is the period of the helix. On the other hand, when the period of the helix is small in comparison with the radius of the helix, the expression for ε is given by Eq (7). The above formulae were employed in the measurements of the permittivity of a number of dielectrics at wavelengths ranging from 18 to 33 cm. The results are shown graphically in Figs 1 and 2; the results of Fig 1 do not take into account the

Card 2/3

SOV/57-29-10-19/18

9.1300

AUTHORS: Shestopalov, V. P., Shishkin, L. A.

TITLE: Slow Electromagnetic Waves in Spiral-Shape Waveguides With Gyrotropic Medium (News in Brief)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1959, Vol 29, Nr 10, pp 1285-1288 (USSR)

ABSTRACT: The paper represents a brief review of literature on the subject of slow electromagnetic waves in spiral-shape waveguides with gyrotropic medium, and is presented under a heading "News in Brief." In particular a waveguide in a ferrite medium is considered. It is stated that equations representing the dispersion (scattering) of the system cannot be used without introducing numerous simplifications. A brief discussion is also given of a spiral-shape waveguide within which there is a plasma, and whose outside surface is adjoined to a dielectric extending radially to infinity. There are 2 figures; and 18 references, 15 Soviet, 1 Swedish, 2 U.S. The U.S. references are: Tien, P. K., P.I.R.E., 41, 11, 1617, 1953; Watkins, D. A.,

Card 1/2

APPROVED FOR RELEASE: 07/13/2001 CIA-RDP86-00513R001549130006-2"

SHESTOPALOV, V.P.; KONDRAT'YEV, B.V.

Space resonance in a helical wave guide located in a magnetodielectric medium. Zhur.tekh.fiz. 29 no.12:1434-1456 D '59. (MIRA 14:6)

1. Khar'kovskiy Gosudarstvennyy Universitet imeni A.M.Gor'kogo. (Wave guides)

SHESTOPALOV, V.P.; ADONINA, A.I.

Effect of recurrent annular slits and of a layer of dielectric material on wave attenuation in a round wave guide. Zhur.tekh. fiz. 29 no.12:1457-1461 D '59. (MIRA 14:6)

1. Khar'kovskiy gosudarstvennyy universitet imeni A.M.Gor'kogo. (Wave guides)

9(6),9(9)

AUTHORS: Shestopalov, V. P., Kondrat'yev, B. V.

SOV/20-125-4-28/74

TITLE: Space Resonance in a Spiral-shaped Wave Guide Placed in a Magnetodielectric Medium (Prostranstvennyy rezonans v spiral'nom volnovode, pomeshchennom v magnitodielektricheskuyu sredu)

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 125, Nr 4, pp 794-797 (USSR)

ABSTRACT: The conditions of zero-th and spatial n-th resonance for a spiral wave guide in free space are $h_o \ll 2\pi/d$, $h_o \approx (2\pi/d)n$ $(n = 1,2,\ldots)$. Here $h_o = \omega/v$ denotes the wave number; ω - the cyclic frequency; d - the spacing of the spiral; v - the phase velocity of the wave in the spiral. The expressions mentioned may be written down also as follows: $d \ll \lambda_g$; $d \sim n\lambda_g$ $(n = 1,2)$, where λ_g denotes the wave length in the spiral wave guide. At high frequencies the above equations may be expressed immediately by the main parameter of the spiral, viz. by the winding angle θ: $d \ll \lambda_o \sin\theta$;

Card 1/4

Space Resonance in a Spiral-shaped Wave Guide Placed in a Magnetodielectric Medium SOV/20-125-4-20/74

$d \sim n\lambda_0 \sin\theta$. Here λ_0 denotes the wave length in free space. For the purpose of determining the conditions of spatial resonance of spiral wave guides located in a magnetodielectric medium, it is necessary to find the dispersion equation for the waves in such a delaying system. It is necessary, in this connection, to distinguish between two possible cases for the arrangement of the magnetodielectric medium with respect to the spiral: 1) There is no interspace between the spiral and the magnetodielectric which is coaxial to it. 2) There is direct contact between the spiral and the magnetodielectric. First, the rather voluminous dispersion relation for the first case is derived; some of the curves plotted according to this dispersion relation are shown by a diagram. In the second case (direct contact between spiral and magnetodielectric) the boundary conditions on the spiral are differently shaped than in the first case. Conditions are also written down for the components of the electric field along the spiral. Next, the complete system of the boundary conditions of the problem is written down in the cylindrical system of coordinates, and herefrom the dispersion equation for the waves in this system

Card 2/4

SOV/20-125-4-28/74

Space Resonance in a Spiral-shaped Wave Guide Placed in a Magnetodielectric Medium

is derived and also specialized for high frequencies. By means of this dispersion relation, it is possible to express the phase velocity v' of the delayed wave in explicit form by quantities which characterize the properties of the medium and of the spiral. In this case v' does not depend on frequency, and this facilitates explicit formulation of the condition of spatial resonance for a wave guide located in a magnetodielectric medium. This condition has the form $d \ll \lambda_0 \alpha \sin \theta$, $d \sim n\lambda_0 \alpha \sin \theta$. The second diagram shows the dispersion curves calculated for various values of $\mathcal{E}$ for the second of the aforementioned two cases. In the first case, the waves are delayed mainly by the spiral, and in the second, however, delay is caused both by the spiral and by the dielectric. The magnetodielectric increases not only the delay, but it also narrows the forbidden zones within which only fast waves are propagated. There are 2 figures and 7 references, 6 of which are Soviet.

Card 3/4

Space Resonance in a Spiral-shaped Wave Guide Placed in a Magnetodielectric Medium SOV/20-125-4-28/74

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet im. A. M. Gor'kogo (Khar'kov State University imeni A. M. Gor'kiy)

PRESENTED: January 5, 1959, by M. A. Leontovich, Academician

SUBMITTED: January 2, 1959

Card 4/4

69897

S/109/60/005/04/010/028
E140/E435

9,1300

AUTHOR: Shestopalov, V.P.

TITLE: Dispersion Properties and Space Resonance in a Helical Waveguide Located in a Magnetodielectric Medium

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol 5, Nr 4, pp 605-620 (USSR)

ABSTRACT: The problem considered is that of a helical waveguide with internal or external dielectric tubes. Special consideration is given to the question of using the helical waveguide to measure the microwave ε of a dielectric. The solution is developed in consideration of an idealized (infinitely thin strip) helix located in a cylindrical waveguide. The medium between the helix and the waveguide is a magnetodielectric. The magnetodielectric is then permitted to extend to infinity and the two cases are considered: a gap between the helix and the medium, no gap. Two concrete problems are then considered: the effect of a thin dielectric layer and periodic ring gaps on the wave attenuation in a round waveguide, the influence of the dimensions of the helical strip on the magnitude of the measured ε of

Card 1/2

88159

S/109/60/005/011/003/014
E140/E485

9,1300

AUTHORS: Bulgakov, B.M., [redacted] V.P., Shishkin, L.A. and Yakimenko, I.P.

TITLE: Symmetrical Surface Waves in a Helical Waveguide Immersed in a Ferrite Medium

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol.5, No.11, pp.1818-1827

TEXT: Suhl and Walker (Ref.3) have considered the dispersion properties of a helical waveguide with external ferrite medium in the presence of a constant transverse magnetic bias. The dispersion equations of such a system contain modified Bessel functions as well as Laguerre or Whittaker functions which complicates the analysis of the characteristic equations. If the magnetic bias field is parallel to the axis of the system, the longitudinal field components in the ferrite and free space are expressed by the modified Bessel functions. The dispersion equation can be analysed more fully therefore than in the case of transverse bias. The article derives the dispersion equation of a helical waveguide placed in a cylindrical cavity in an infinite ferrite medium. In cylindrical coordinates, the waveguide passes

Card 1/2

9.1300

77322
SOV/57-30-1-1/18

AUTHORS: Shestopalov, V. P., Spol'nik, L. I.

TITLE: Dispersion Properties of a Coaxial Helical Line Immersed in a Magnetodielectric

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1960, Vol 30, Nr 1, pp 3-14 (USSR)

ABSTRACT: It is of interest to investigate the dispersion properties of a coaxial helical line immersed in a dielectric, using as the basic approximation the Floquet theorem for periodical structures. One is bound to assume that current in the helix satisfies the general requirements of the theorem, except that the compulsion factor is arbitrary. The authors obtain solution for normal waves using the requirement that they should not allow either the active or the reactive power to escape beyond the surface of the current strip. They show that in specified limiting cases the newly developed and then simplified

Card 1/10

$\frac{2\pi}{d} z - \Theta$ = const, the current density is in the form of a traveling wave. The authors next write the components of **K** in the cylindrical coordinate system in the form:

$$K_{\theta} = f\left(\frac{2\pi}{d} - z\right) e^{-ih_{0}z}; \quad K_{z} = g\left(\frac{2\pi}{d} - z\right) e^{-ih_{0}z}. \qquad (2)$$

Note that owing to their single-valuedness with respect to Θ , f, and g, functions must be periodic in Θ with a period of 2π, which ensures that Eqs.(2) agree with the Folquet theorem. Equations (2) are most general, and f and g parts describe the current density distribution in the cross section of the strip. After Fourier-analyzing Eqs. (2), the authors compute the fields for the general case, and for the case when the waveguide is missing.

speaking, neither active nor reactive power is crossing the surface of the strip. After appropriate transformations the dispersion relations may be written in the form:

$$\sum_{m=-\infty}^{+\infty} |K_{\|m}|^2 \frac{1}{\gamma_m a} \left\{ \frac{I'_m(a)}{I_m(a)} \cdot \frac{\dfrac{K'_m(c)}{I'_m(c)} - \dfrac{K'_m(a)}{I'_m(a)}}{\dfrac{\mu_1}{\mu_2}\left[\dfrac{K'_m(c)}{I'_m(c)} - \dfrac{K_m(a)}{I_m(a)}\right] - \left[\dfrac{K'_m(c)}{I'_m(c)} - \dfrac{K'_m(a)}{I'_m(a)}\right]} - \frac{I_m(a)}{I'_m(a)} \cdot \frac{\left[\dfrac{K_m(c)}{I_m(c)} - \dfrac{K_m(a)}{I_m(a)}\right]\left[\dfrac{\gamma_m a}{ka \operatorname{ctg}\psi} - \dfrac{m h_m a}{ka\gamma_m a}\right]^2}{\dfrac{\varepsilon_2}{\varepsilon_2}\left[\dfrac{K_m(c)}{I_m(c)} - \dfrac{K'_m(a)}{I'_m(a)}\right] - \left[\dfrac{K_m(c)}{I_m(c)} - \dfrac{K_m(a)}{I_m(a)}\right]} \right\} = 0. \qquad (14)$$

where $\gamma_m = \sqrt{h_m^2 - k^2 \varepsilon\mu}$; $h_m = h_o + \frac{2\pi m}{d}$; I_m and K_m are modified Bessel functions; m labels the m-th

Fourier component. For $\mu_1 = \mu_2 = \mu$, $\varepsilon_1 = \varepsilon_2 = \varepsilon$, (14) goes over into the dispersion relation obtained by Stark (see ref). For the m-th Fourier component of the parallel density distribution on the helix, the authors use Stark's expression:

$$K_{\parallel m} = \frac{I}{d\cos\psi} J_0\left[\left(m + \frac{h_0 a}{\operatorname{ctg}\psi}\cos^2\psi\right)\frac{\pi b}{d}\right]. \qquad (16)$$

obtained assuming: that the parallel component of the current along the strip tends to infinity as the inverse square root of the distance from the edge of the strip; that the current density is symmetrical over its cross section; and that the distribution curves of constant phases are lines perpendicular to the strip edges. In the equation, I is amplitude of the linear current; J_0 is Bessel's function of the first kind, zero order. To simplify Eq. (14), the authors first note that the phase velocity of the m-th component in the ka, $h_o a$ coordinates is given by:

$$\frac{v_{ph,m}}{c} = \frac{k}{h_m} = \frac{ka}{h_0 a + m \operatorname{ctg} \psi} . \tag{17}$$

The m-th phase velocity in units of the speed of light c for a given point of the characteristics of propagation in the ka, $h_o a$ coordinates is then determined by the slope of the line passing through the point m cot ψ on the $h_o a$ axis and the point on the characteristics, Fig. 1.

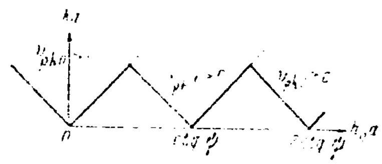


Fig. 1.

The boundary of the forbidden regions is obtained from condition $\frac{v_{ph.\,m}}{c} = 1$, which leads to:

$$ka = h_0 a + m \operatorname{ctg} \psi. \qquad (18)$$

All equations obtained will give fields with a phase velocity smaller than the speed of light. If in the case of m-th field $v_{ph.\,m} > c$, its radial dependence is of an oscillatory nature, the solutions are of a special kind and will be discussed separately. In the allowed region fields with m = -s (where s = integers) have the largest phase velocity, while phase velocities of other fields are small compared to the velocity of light, and they are localized in the vicinity of the helical strip. The m = -s fields

Dispersion Properties of a Coaxial Helical Line Immersed in a Magnetodielectric

77322
SOV/57-30-1-1/18

of $\frac{v_{ph.m}}{c}$ for higher frequencies are given by:

$$\frac{v_{ph.m}}{c} \approx \sqrt{\frac{1+\frac{\mu_2}{\mu_1}}{1+\frac{\varepsilon_2}{\varepsilon_1}}} \sin\psi. \quad (28)$$

for the zero, first, and second order. Figure 3 shows typical dispersion curves for $\psi = 10^{\circ}$, c/a = 2, b/d = 0.1; $\frac{\mu_2}{\mu_1} = 1$ and $\frac{\varepsilon_2}{\varepsilon_1} = 1, 2, 81$ (curves 1, 4, 6). Curves 2, 5, 8 are for b/d = 0.5, all the other relations being the same, and curves 3, 7 for b/d = 0.9; $\frac{\varepsilon_2}{\varepsilon_1} = 1, 2$.

Card 10/16

Dispersion Properties of a Coaxial Helical Line Immersed in a Magnetodielectric

77322
SOV/57-30-1-1/18

The authors state that a variation of b/d between 0.1 and 0.5 increases somewhat the retardation of the system while the influence of $\frac{\varepsilon_2}{\varepsilon_1}$ and $\frac{\mu_2}{\mu_1}$ on the retardation rapidly weakens with the increase in the distance of the magnetodielectric form from the helix. In the case of fast wave with phase velocity higher than c, $ka > h_m a$; $\gamma_m = ig_m$; expression:

$$\left[\frac{q_m a}{ka \operatorname{ctg} \psi} + \frac{m h_m a}{ka q_m a}\right]^2$$

transforms into:

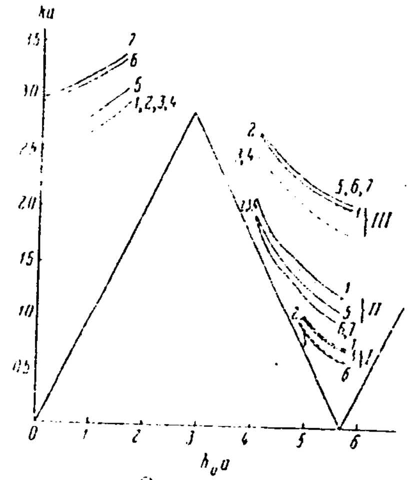
$$\left[\frac{(ka)^2 - (h_0 a)^2}{(ka \operatorname{ctg} \psi)^2} + \frac{m^2}{(q_m a)^2}\right]$$

Card 12/16

Dispersion Properties of a Coaxial Helical Line Immersed in a Magnetodielectric

77322
SOV/57-30-1-1/18

The authors discuss the case of the zero and the first space resonance.



Card 14/16

Fig. 8

Dispersion Properties of a Coaxial Helical Line Immersed in a Magnetodielectric

77322
SOV/57-30-1-1/18

A. A. Bulgakov assisted in calculating the dispersion curves. There are 8 figures; and 10 references, 9 Soviet, 1 U.S. The U.S. reference is: L. Stark, J. Appl. Phys., 25, 9, 1155, 1954.

ASSOCIATION: Khar'kov State University imeni A. M. Gor'kiy (Khar'kovskiy gosudarstvennyy universitet imeni A. M. Gor'kogo)

Card 16/16

Consideration of the Periodic Properties of a Spiral in Measuring the Dielectric Constant in Substances by Means of the Spiral Waveguide Method

S/057/60/030/04/09/009
B004/B002

The substances investigated were: viniplast, porcelain, and ebonite. Data are given in Table 1. The results of measurements with and without taking periodicity into account, are shown in Table 2. With narrow-band windings, the action of 2b and d upon the dispersion properties is slightly stronger. There are 1 figure, 2 tables, and 4 Soviet references.

ASSOCIATION: Khar'kovskiy gosuniversitet im. A. M. Gor'kogo (Khar'kov State University imeni A. M. Gor'kiy)

SUBMITTED: July 2, 1959

/B

Card 2/2

APPROVED FOR RELEASE: 07/13/2001 CIA-RDP86-00513R001549130006-2"

SHESTOPALOV, V.P., SLYUSARSKIY, V.A., ANDRENKO, S.D., CHERNYAKOV, E.I.

Electromagnetic waves in a spiral wave guide with an anisotropic dielectric. Zhur. tekhn. fiz. 30 no.6:644-652 Je '60. (MIRA 13:8)

1. Khar'kovskiy gosudarstvennyy universitet im. A.M.Gor'kogo. (Electromagnetic waves) (Wave guides)

SHESTOPALOV, V.P., SLYUSARSKIY, V.A., YATSUK, K.P.

Investigating delay systems of the type spiral-anisotropic dielectric and spiral-finned structure. Part 2. Zhur. tekh. fiz. 30 no.7:835-839 Jl '60. (MIRA 13:8)

1. Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo.
(Radio circuits)

BULGAKOV, B.M., SHESTOPALOV, V.P., SHISHKIN, L.A., YAKIMENKO, I.P.

Slow waves in a spiral wave guide with plasma. Zhur. tekh. fiz. 30 no.7:840-850 Jl '60. (MIRA 13:8)

1. Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo.
(Wave guides) (Plasma (Ionized gases))

S/020/60/133/04/16/031
B019/B060

AUTHORS: Kalmykova, S. S., Shestopalov, V. P.

TITLE: The Theory of the Modified Spiral With a Counter Winding

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 133, No. 4, pp. 813-816

TEXT: Fig. 1 shows the system defined by the authors as a modified spiral with counter winding. The same figure also depicts five cases of different current distributions in the modified spiral. For the case (Fig. 1) in which the longitudinal component of the electric field on the axis differs from zero, the Fourier coefficients of the currents are given by the equation system (1). The dispersion equation of the system for this case is written down with formula (2). By a comparison of the dispersion curve, shown in Fig. 2, with that of a double spiral with a counter winding, it is shown that there are no differences between them in the region of longer waves. The physical causes of these properties of the spirals are discussed. Subsequently, the authors compare with the help of a diagram (Fig. 3) between the energy densities of the first

Card 1/2

The Theory of the Modified Spiral With a Counter Winding

S/020/60/133/04/16/031
B019/B060

three components of an ordinary spiral, a double spiral with a counter winding, and that of the system considered here. The advantages offered by the system investigated here, which basically consist of a considerably lower stored energy of the system, are discussed. A comparison of the impedances of the three systems considered here, is made in Fig. 4. The impedance of the system under investigation is found to be larger compared to the other two. Finally, the authors discuss the dispersion equations for the other four cases of current distribution (Fig. 1) and then state that a comparison of the results obtained here with those from other papers (Refs. 7, 8, 9) yields a good agreement between theory and experiments. There are 4 figures and 9 references: 6 Soviet and 3 US.

√B

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo (Khar'kov State University imeni A. M. Gor'kiy)

PRESENTED: March 4, 1960, by M. A. Leontovich, Academician

SUBMITTED: March 3, 1960

Card 2/2

ZINCHENKO, Nikolay Semenovich; KALININ, V.I., prof., retsenzent [deceased]; TARANENKO, V.P., dotsent, retsenzent; SHESTOPALOV, V.P., dotsent, retsenzent; CHERNYAYEV, L.K., kand. tekhn. nauk, otv. red.; TRET'YAKOVA, A.N., red.; ALEKSANDROVA, G.P., tekhn.red.

[Lecture course on electron optics] Kurs lektsii po elektronnoi optike. Izd.2., ispr. i dop. Moskva, Izd-vo Khar'kovskogo gos. univ. im. A.M.Gor'kogo, 1961. 361 p. (MIRA 14:9)

(Electron optics)

26801
S/142/61/004/002/003/010
E033/E435

9.4230

AUTHORS: Shestopalov, V.P., Kondrat'yev, B.V., Slyusarskiy, V.A.

TITLE: An electron beam in a coaxial spiral line with an anisotropic magneto-dielectric medium

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiotekhnika, 1961, Vol.4, No.2, pp.155-164

TEXT: The propagation of electromagnetic waves in a coaxial, spiral line with an electron beam is investigated; the space between the spiral and the outer sheath being filled with an anisotropic magneto-dielectric medium. The article is divided into seven sections:

1. The spiral line consists of three ($i = 1,2,3$) regions: $i = 1 (0 \leqslant r \leqslant a)$ inside which a continuous, cylindrical, mono-energetic electron beam is propagated along the z axis of the system; $i = 2 (a \leqslant r \leqslant b)$ the region between the beam and the spiral; $i = 3 (b \leqslant r \leqslant r_0)$ the region between the spiral and the sheath, which is filled with the anisotropic magneto-dielectric medium; ($r = a, b, r_0$ are the radii of the beam, of the spiral and of the sheath respectively; j_z is the beam current density).

Card 1/6

26801
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E033/E435

An electron beam ...

By using the field equations and the equation of motion of the charge and assuming small signals, the first relationship between the propagation constant h_n and the separation constant of the variables χ_n is obtained (from previous works quoted in the references)

$$(h_n^2 - \chi_n^2)(h_n - k_o)^2 = \frac{k_o}{k_1} \eta s (h_n^2 - k_1^2) \qquad (1)$$

where $\eta = \sqrt{\mu_o/\varepsilon_o}$; $k = \omega/c$; $k_1^2 = k^2 \varepsilon_o \mu_o$; ε_o and μ_o are the dielectric permittivity and magnetic permeability of the medium; $k_o = \omega/V_o$, the wave number, corresponding to the mean velocity of the electrons v_o; $s = (4\pi/c)(j_o/2U_o)$, where U_o is the constant potential difference given by $v_o^2 = (2e/m)(U_o)$; e is the charge and m the mass of an electron. The total current $j_z \cong f_t \cong j_o (j_z = j_\varphi = 0)$. The index $n = 1,2,3,4$ indicates the number of the solution of the differential equation for h_n and χ_n. The propagation constant h_n determines the nature of the electromagnetic wave propagated in the line.

2. Expressions for the longitudinal components of the electric

Card 2/6

26801
S/142/61/004/002/003/010
E033/E435

An electron beam ...

and magnetic fields in regions $i = 1,2$ are obtained. The remaining components of the fields are derived from the longitudinal components. The longitudinal components of the electric and magnetic fields in region 3 are obtained by using the diagonal tensors $\varepsilon_{ik} = (\varepsilon_r, \varepsilon_\varphi, \varepsilon_z)$ and $\mu_{ik} = (\mu_r, \mu_\varphi, \mu_z)$. The remaining components of the electro-magnetic fields in this region are derived from the longitudinal components.

3. To determine the propagation constants h_n and χ_n, the dispersion equation of the system is first obtained by using the boundary conditions at the surfaces of the beam, of the spiral and of the sheath for each of the n components of the fields. At the boundary of the electron beam, the condition of continuity of the tangential components of the electromagnetic field must be observed; at the surface of the sheath, these components must equal zero. At the surface of the spiral waveguide (assuming an equivalent isotropic-conducting cylinder), the tangential components of the electric field are zero and the components of the magnetic field inside and outside the spiral in the direction of its conductivity are continuous. From these conditions, the

Card 3/6

26801
S/142/61/004/002/003/010
E033/E435

An electron beam ...

amplitudes of the fields are expressed as $A_{1n} \cong E_{nz}(0)$, the strength of the longitudinal components of the electric field along the axis of the system. Thence, the dispersion equation is obtained. It is shown that the dielectric properties of the medium have much greater effect on the interaction of the field and the beam than the magnetic properties.

4. The simplified asymptotic form of the dispersion equation is used to find the value of the retardation. It is shown that the conditions for space-resonance for a spiral waveguide in an anisotropic medium are analogous to the same conditions for an isotropic magneto-electric. At low frequencies, the interaction of the waves with the beam is small.

5. The asymptotic form of the dispersion equation is also used for the case when $a \cong b \ll r_o$. Since a weak beam introduces very little change into the system, the excitation theory may be applied and equations for the reverse and forward waves obtained. The cubic equation for the forward wave gives three solutions and four sets of propagation parameters (one set for the reverse wave h_1, χ_1, and three sets $h_{2,3,4}$, $\chi_{2,3,4}$ for the forward waves) are obtained. These show that the amplitudes of the waves with

Card 4/6

26801
S/142/61/004/002/003/010
E033/E435

An electron beam ...

propagation constants h_1 and h_2 are constant, but waves with h_3 and h_4 have amplitudes which change proportionally to $\exp(\pm z \cdot \operatorname{Im} h_{3,4})$. The amplitude change depends on the current density and on the parameters of the medium. The phase velocities are also investigated.

6. The power "fluxes" inside the spiral and between the spiral and the sheath are next investigated and simplified asymptotic expressions obtained. At high frequencies and with no sheath the total power flow is proportional to the general dielectric permittivity and inversely proportional to the permeability. The distribution of power inside and outside the spiral is investigated and comparisons made of the power "fluxes" in systems with an anisotropic magneto-dielectric and with a vacuum, with and without a sheath, at high and at low frequencies.

7. Finally, expressions are obtained for the wave and coupling impedance. It is shown that at high frequencies, the coupling impedance decreases with frequency but increases with increase in beam diameter. At low frequencies the coupling impedance is very much higher than at high frequencies. There are 12 Soviet references.

Card 5/6

S/024/61/000/002/012/014
E140/E163

9.4231

AUTHORS: Kalmykova, S.S., Tret'yakova, S.S., and Shestopalov, V.P. (Khar'kov)

TITLE: Propagation of electromagnetic waves in a modified contra-wound helix enclosed in a cylindrical waveguide

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Energetika i avtomatika, 1961, No.2, pp.159-164

TEXT: The article considers the contra-wound helix proposed in Refs.1 and 2 (Ref.1: S.S. Kalmykova, V.P. Shestopalov, DAN SSSR, 1960, No.4, 133. Ref.2: C.K. Birdsoll and T.E. Everhart. Contra-wound helix circuit for high power traveling wave tubes. IRE Trans. Electr. Devices, 1956, ED-3, 4), enclosed in a shield. Curves are given for the dispersion, delay, group velocity as a function of frequency, and power transfer. It is found that the waveguide screen increases the delay, decreases dispersion and improves the bandwidth of the system; the group velocity of the slow electromagnetic waves is further decreased; the impedance of the zero harmonic in the screen helix is increased by comparison with the unscreened helix; the ratio of impedance at the zero- and

√B

Card 1/2

9.1300

S/141/61/004/004/014/024
E140/E435

AUTHORS: Shestopalov, V.P., Adonina, A.I.

TITLE: On helical waves in a helical waveguide

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, v.4, no.4, 1961, 703-711

TEXT: The authors apply the helical coordinate system proposed by R.A.Waldron (Ref.4: Quart J. Mech. Appl. Math., v.11, 4 (1958)) and averaged boundary conditions to obtain the dispersion equations and formulae for the attenuation of TE and TH-helical waves in a tape helical waveguide. There are 6 figures and 6 references: 5 Soviet-bloc and 1 non-Soviet-bloc. The reference to an English language publication is quoted in the text.

B

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet (Khar'kov State University)

SUBMITTED: January 31, 1961

Card 1/1

APPROVED FOR RELEASE: 07/13/2001 CIA-RDP86-00513R001549130006-2"

21432

S/109/61/006/001/010/023
E140/E163

Unilateral wave propagation in ...

vector ellipse eccentricity. The present authors have previously (Ref.3) published an electrodynamic solution of the problem for lossless systems. The present note solves the same problem for systems with dielectric and magnetic losses having a ferro-resonant character. The analysis predicts directivities of up to 8:1, a result useful for the design of ferrite attenuators for TWT-amplifiers. On the basis of the formulae obtained curves have been calculated which permit the following conclusions. (1) The directivity has a maximum in the neighbourhood of a resonant frequency, of the order of 8:1. (2) The dependence of attenuation of magnetization for a given magnetic field is weak. (3) At frequencies equidistant from resonance the attenuation increases as the magnetic field decreases. (4) In the presence of high dielectric losses frequency bands are possible in which the backward attenuation is lower than the forward attenuation. Thus the dependence of attenuation ratio and of absolute attenuation on the dielectric loss have the same character. It is necessary to take ferrites with the lowest possible dielectric loss.

Card 2/3

21432

Unilateral wave propagation in ... S/109/61/006/001/010/023
E140/E163

There are 5 figures and 5 references: 3 Soviet and 2 English.

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo (Khar'kov State University imeni A.M. Gor'kiy)

SUBMITTED: February 15, 1960

X

Card 3/3

21433
S/109/61/006/001/011/023
E140/E163

Coaxial delay line consisting of two opposed helices filled with magneto-dielectric medium

There are 8 figures, 1 table and 5 references: 2 Soviet and 3 English.

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo (Khar'kov State University imeni A.M. Gor'kiy)

SUBMITTED: April 2, 1960

Card 2/2

22903

9,9000

S/109/61/006/004/018/025
E032/E314

AUTHORS: Shestopalov, V.P. and Yakimenko, I.P.

TITLE: On the Attenuation of Slow Electromagnetic Waves in a Plasma Rod Located in the Longitudinal Magnetic Field

PERIODICAL: Radiotekhnika i elektronika, 1961, Vol. 6, No. 4, pp. 653 - 654

TEXT: The dispersion equation for a plasma rod in a longitudinal magnetic field was investigated by Faynberg and Gorbatenko (Ref. 1) without taking losses into account. This equation was obtained by Bulgakov et al in Ref. 2, and is of the following form

$$\varepsilon_z f \frac{I_{11} I_{12}}{I_{01} I_{02}} + \frac{\sqrt{f_0}}{2 f_1 \sqrt{\varepsilon}} \left\{ [\varepsilon_z - 1 + (\varepsilon_z + 1) f_1] f_+ \frac{I_{11}}{I_{01}} - \right.$$

$$\left. - [\varepsilon_z - 1 - (\varepsilon_z + 1) f_1] f_- \frac{I_{12}}{I_{01}} \right\} \frac{K_{10}}{K_{00}} + \frac{f_- f_+}{|\varepsilon|} \frac{K_{10}^2}{K_{00}^2} = 0, \qquad (1)$$

Card 1/6

22903

c is the velocity of light in vacuum,
a is the radius of the plasma rod,
$I_o(x)$ and $K_o(x)$ are the modified Bessel functions of the first and second kind.

Eq. (1) can be used to determine the dispersion of slow electromagnetic waves. It holds in the shaded region of Fig. 1. This region is bounded by the curves $\varepsilon_z = 0$, $\varepsilon\varepsilon_z = 1$ and $(\ell\sigma)^2 = 2(\sigma - 1)/(\sigma - 2)$ where $\ell = \omega_o/\omega$ and ω_o is the Langmuir plasma frequency. If the attenuation of the waves is not too large, then the various terms in Eq. (1) can be expended and only the linear terms retained. For $m > 10$, the dispersion equation assumes the following simple form

22903

'On the Attenuation S/109/61/006/004/018/025 E032/E314

$$\varepsilon' = 1 + \frac{(l\sigma)^2}{\sigma^2 - 1}; \quad \varepsilon'' = \frac{\left(1 + \frac{1}{\sigma^2}\right) l^2 \sigma \delta}{\left(1 - \frac{1}{\sigma^2}\right)^2}; \quad \varepsilon_z' = 1 - (l\sigma)^2; \quad \varepsilon_z'' = l^2 \sigma^3 \delta; \; \delta = \frac{\nu}{\omega_H}; \tag{5}$$

In these relations ν is the effective collision frequency in the plasma, and $(I_1/I_o)'$, $(K_1/K_o)'$ are the derivatives of the Bessel function ratios with respect to the argument.

The arguments of the functions I_1 and K_1 are respectively equal to $\beta'\sqrt{\varepsilon_z' a/\varepsilon'}$ and $\beta' a$. The expressions in Eq. (5) will hold if the working frequency is very different from the gyrofrequency ($\sigma \neq 1$). These formulae are shown graphically in Figs. 2 and 3.

Card 5/6

9.1925

24872 S/109/61/006/007/012/020
D262/D306

AUTHORS: Shestopalov, V.P., Bulgakov, A.A., and Bulgakov, B.M.

TITLE: Theoretical and experimental analysis of helical-dielectric antennae

PERIODICAL: Radiotekhnika i elektronika, v. 6, no. 7, 1961, 1136 - 1145.

TEXT: Dielectric and helical antennae are widely used in SHF range as the antennae for travelling waves. They consist of sections of a dielectric or helical waveguides, along which the electromagnetic wave can be propagated with a phase velocity v_f less than the velocity of light c in the free space. In a helical dielectric antennae there should be properties common both to the helical and to the dielectric antenna. In particular, its geometrical dimensions, for given angle of the helix ψ and for given dielectric constant ε, should be smaller. In the present article the theoretical and experimental study of such antennae is presented. The theoretical analysis is

Card 1/5

$$f_{sn} = \frac{\sin \frac{\Delta n}{2}}{\frac{\Delta n}{2}}, \quad \Delta = \frac{2p}{\pi\delta}. \tag{9}$$

the non-resonant term of which is

$$S = 2\left[\left(\frac{\gamma_0 a}{k_2 a}\right)^2 \mathrm{tg}^2\,\psi\,\frac{1}{\varepsilon_1 + \varepsilon_2} - \frac{1}{\frac{1}{\mu_1} + \frac{1}{\mu_2}}\right]\sin\psi \ln\frac{2}{\Delta}. \tag{10}$$

2) The increase in time delay in the helix dielectric waveguide results in a greater directivity of radiating into the free space energy. This is established by applying Kirchhoff's integral method to the electric field $\vec{E}_m$

$$\vec{E}_M = \frac{ie^{-ik_0 R}}{k_0 R}\int_0^l e^{2\pi i z\left(\frac{\cos\Theta}{\lambda_0} - \frac{1}{\lambda_g}\right)} dz \int_0^{2\pi} \vec{V}(\varphi, \Theta, \Phi)\, d\Phi, \tag{13}$$

21872

[illegible]

be steady. $\mathcal{E}$ and $\mathcal{H}$ denote the field strengths on the surface S dividing the volume V into the regions 1 and 2; $\vec{j}_0^{e,h}$ denotes the electric current and magnetic flux, $j_{1,2}^{e,h}$ the linear homogeneous operators of the magnetic and the electric impedance, respectively, on the surface S on the side of region 1 and 2, respectively. When the Ritz method is employed, and $\mathcal{E}$ and $\mathcal{H}$ are approximated by linear combinations $a_1\omega_1 + a_2\omega_2 + \ldots + a_n\omega_n$, the condition (1) for the functional $K^{e,h}$ will consist of the system of equations $\partial K^{e,h}/\partial a_i = 0$ representing the variated parameters. These equations play the role of approximate boundary conditions. Fig. 1 shows the modified spiral with the counter-winding and the path of the currents on its surface. The current is approximated by the double Fourier expansion

$$\mathbf{j} = \sum_{n,m} \mathbf{j}_{n,m} e^{i\frac{2\pi n z}{D}} e^{im\varphi} e^{ih_0 z}. \tag{2}$$

$$\left.\begin{aligned} E_z &= \sum_{n,m} \begin{Bmatrix} I_m(\beta_n a) K_m(\beta_n r) \\ K_m(\beta_n a) I_m(\beta_n r) \end{Bmatrix} i\frac{\beta_n^2 a^2}{ka}\left(j_{znm} - \frac{h_n a m}{\beta_n^2 a^2} j_{\varphi nm}\right) e^{-ih_n z} e^{im\varphi} e^{i\omega t}, \\ H_z &= \sum_{n,m} -\beta_n a \begin{Bmatrix} I'_m(\beta_n a) K_m(\beta_n r) \\ K'_m(\beta_n a) I_m(\beta_n r) \end{Bmatrix} j_{\varphi nm} e^{-ih_n z} e^{im\varphi} e^{i\omega t}, \end{aligned}\right\} \tag{3}$$

Card 2/11

I_m, K_m are the modified Bessel functions of m-th order, $\beta_n^2 = h_n^2 - k^2, h_n = h_o + (2\pi n)/D, h_o = \omega/v_o$, $k = \omega/c$ (ω - frequency, c - velocity of light). The authors employ the expansion $\vec{j} = \sum_{n,m} \vec{a}_{\mu\nu}\omega_{\mu\nu}$. The problem is solved in simple one-term approximation. When the charges do not accumulate on the band edges, j_z and j_φ read as follows:

$$j_z = \begin{cases} -\frac{A}{2b}\left(\frac{D}{2} - b + z\right), & -\frac{D}{2} - b \leqslant z \leqslant -\frac{D}{2} + b, \quad \pi - \varphi_0 \leqslant \varphi \leqslant \pi + \varphi_0; \\ \frac{A}{2b}\left(\frac{D}{2} + b + z\right), & -\frac{D}{2} - b \leqslant z \leqslant -\frac{D}{2} + b, \quad -\varphi_0 \leqslant \varphi \leqslant \varphi_0; \\ A, & -\frac{D}{2} + b \leqslant z \leqslant -b, \quad -\varphi_0 \leqslant \varphi \leqslant \varphi_0; \\ -\frac{A}{2b}(z - b), & -b \leqslant z \leqslant b, \quad -\varphi_0 \leqslant \varphi \leqslant \varphi_0; \\ \frac{A}{2b}(z + b), & -b \leqslant z \leqslant b, \quad \pi - \varphi_0 \leqslant \varphi \leqslant \pi + \varphi_0; \\ A, & b \leqslant z \leqslant \frac{D}{2} - b, \quad \pi - \varphi_0 \leqslant \varphi \leqslant \pi + \varphi_0. \end{cases} \quad (4)$$

$$\left.\begin{aligned} &j_{z00}=A2\varphi_0 D; \quad j_{zmn}=\frac{A}{2b}\,\frac{\sin m\varphi_0}{im}\,\frac{2\sin\frac{2\pi nb}{D}}{\left(\frac{2\pi n}{D}\right)^2}[(-1)^n-1][(-1)^m-1];\\ &j_{\varphi00}=0; \quad j_{\varphi nm}=\frac{aA}{2b}\,\frac{\sin m\varphi_0}{m^2}\,\frac{2\sin\frac{2\pi nb}{D}}{i\,\frac{2\pi n}{D}}[(-1)^n-1][(-1)^m-1]. \end{aligned}\right\} \quad (6)$$

and the dispersion equation has the following form:

$$I_0(\beta_0 a)K_0(\beta_0 a)\beta_0^2 a^2+4\frac{a^2}{D^2}\sum_{n,\ m\neq 0}\left\{I_m(\beta_n a)K_m(\beta_n a)\left(\frac{a\beta_n}{\frac{2\pi na}{D}}-\frac{h_n a}{\beta_n a}\right)^2+\right.$$

$$\left.+I'_m(\beta_n a)K'_m(\beta_n a)\frac{k^2a^2}{m^2}\right\}\frac{\sin^2 m\varphi_0}{m^2\varphi_0^2}\,\frac{\sin^2\frac{2\pi nb}{D}}{\left(\frac{2\pi nb}{D}\right)^2}\times$$

$$\times[(-1)^n-1][(-1)^m-1]=0. \quad (7)$$

This equation differs from the equation of a spiral with counter-winding above all in the double sum and, besides the zeroth harmonic, it contains only odd harmonics with respect to z and φ. The following are the conditions for zeroth and first resonance: $h_0 D/2\pi \ll 1$; $h_{-1} D/2\pi \ll 1$ (8). In this case, Eq. (7) assumes the form

(9)

where $const_1$ and $const_2$ depend on the parameters of the system. With long waves, there are no essential differences between the dispersion curve of a spiral with cross winding and its modifications, for the structure of both systems differs only insignificantly, and their dispersive properties are much alike. A shorter radius of the system improves dispersion but increases the ratio v_{Φ}/c. A broadening of the metal band has a similar effect. The following holds for any parameters: At $0.3-0.4 \ll ka \ll 0.8-0.9$, phase velocity v_{Φ} and group velocity v_{gr} decrease. Near ka = 1 (0.8 - 0.9), v_{Φ} has a minimum and v_{gr} tends toward zero. For $\infty < \lambda_g < D$ in the range $0.3 \ll ka \ll 0.8$, the zeroth harmonic becomes the minus-first, spatial resonance is not present, and the higher harmonics make a considerable contribution to dispersion. The energy transferred by tne main component of the field is significant only in the range of zeroth resonance, and decreases considerably already at ka = 0.2. Fig. 6 shows the energy density W for the first three components of an ordinary spiral (I), a double spiral with cross winding (II), and of the system under consideration (III). The impedances of these systems are intercompared in Fig. 7. In the range of λ_g, the differences in the configurations of the spirals become essential and their dispersive properties differ greatly. The dispersion equation for the case 1б reads as follows:

$$\left\{ \sum_{m\neq 0} I_m(\beta_0 a) K_m(\beta_0 a) \frac{D^2}{a^2} \beta_0^2 a^2 \frac{\sin^4 \frac{m\varphi_0}{2}}{m^2} [(-1)^m + 1] - \right.$$

$$- k^2 a^2 \varphi_0^4 \sum_{n\neq 0} I_1(\beta_n a) K_1(\beta_n a) \frac{\sin^2 \frac{2\pi nb}{D}}{\left(\frac{2\pi nb}{D}\right)^2} [(-1)^n - 1] + 8 \sum_{m,\, n\neq 0} I_m(\beta_n a) K_m(\beta_n a) \times$$

$$\left. \times \left(\frac{\beta_n a}{\frac{2\pi an}{D}} - \frac{h_n a}{\beta_n a} \right)^2 + \frac{k^2 a^2}{m^2} I'_m(\beta_n a) K'_m(\beta_n a) \right\} \frac{\sin^2 \frac{2\pi nb}{D}}{\left(\frac{2\pi nb}{D}\right)^2} \frac{\sin^4 \frac{m\varphi_0}{2}}{m^2} \times$$

$$\times [(-1)^n - 1][(-1)^m + 1] = 0 \qquad (11)$$

27173
S/057/61/031/009/013/019
B104/B102

9,1300

AUTHORS: Shestopalov, V. P., Tremʹyakov, O. A., and Kalmykova, S. S.

TITLE: Dispersion properties of a split waveguide with narrow baffle plates

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 9, 1961, 1104-1111

TEXT: A new kind of slowing-down systems called "split waveguide with narrow baffle plates" is described. From the standpoint of general symmetry, the system corresponds to a bifilar helix (c.f. Fig. 1). It is shown that the existence of narrow baffle plates changes considerably the dispersion properties of the system studied. The system was studied by a method developed by M. Chodorow et al. (J. Appl. Ph., 26, no. 1, 1956) on the basis of the dispersion equation

$$\sum_{m,n}\left\{\left[m^2\frac{h_n^2a^2}{\beta_n^2a^2}I_mK_m+k^2a^2I'_mK'_m\right]|J_{\varphi_{mn}}|^2+\beta_n^2a^2I_mK_m|J_{z_{mn}}|^2-\right.$$
$$\left.-mh_naI_mK_m(J^*_{\varphi_{mn}}J_{z_{mn}}+J_{\varphi_{mn}}J^*_{z_{mn}})\right\}=0, \quad (1)$$

Card 1/6

27173
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B104/B102

Dispersion properties of a split ...

numerically by successive approximation. The roots of these equations are given in Table 4. Fig. 3 shows the dispersion curves in coordinates, as used by Chodorow in Ref. 2. It is concluded that the system studied has the same quantity of spatial harmonics as the bifilar winding investigated by Chodorow. There are 4 figures, 4 tables, and 6 references: 2 Soviet and 4 non-Soviet. The three references to English-language publications read as follows: L. Stark, J. Appl. Ph., 25, no. 9, 1954; C. K. Birdsall et al., IRE Trans. on ED, Ed-3, no. 4, 1956; I. E. Newin, IRE Trans. on Ed, 1959, April, p. 1959.

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet im. A. M. Gor'kogo (Khar'kov State University imeni A. M. Gor'kiy)

SUBMITTED: July 8, 1960

Card 3/6

30101
S/057/61/031/011/016/019
B125/B102

9.1300 (1127)

AUTHORS: Shestopalov, V. P., and Tret'yakov, O. A.

TITLE: Qualitative analysis of dispersion equations of some cylindrical periodic structures

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 11, 1961, 1379-1387

TEXT: The authors analyze the dispersion equations for some retarding periodic structures of the cylindrical type established by a variation method of M. Chodorow and E. L. Chu. (J. Appl. Phys., 26, no. 1, 1955). The solution of $\text{curl curl}\,\vec{E} + k^2\vec{E} = 0$ with the boundary conditions $[\vec{n} \times \vec{E}] = 0$ is equivalent to the determination of k^2 as minima of the functional $k^2 = \int_V |\vec{E}|\,dv / \int_V |\text{curl curl}\,\vec{E}|\,dv$ for the same boundary conditions. This corresponds, in first approximation, to the disappearance of the flux of complex power from a volume V of the system, the volume being wholly or partly enveloped by a conducting surface: $\int_V \vec{j}\vec{E}\,dv = \int_V (J_zE_z + J_\varphi E_\varphi + J_rE_r)\,dv = 0$

Card 1/5

30101
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B125/B102

periodic with respect to the radius, is solved by the method of successive approximations. The authors point to the individual steps of the computing operation, and difficulties arising therein. A knowledge of the character of the dispersion curve and the range which may be traversed by this curve may be useful in this connection. All this permits a qualitative analysis of retarding periodic, cylindrical systems. The dispersion curve of this retarding system can be qualitatively determined with the aid of

$$\sum_{m,\,n=-\infty}^{\infty}\left\{ Z_{mn}|J_{zmn}|^2+\Phi_{mn}|J_{\varphi mn}|^2+\Psi_{mn}\left(J_{zmn}J^{*}_{\varphi mn}+J^{*}_{zmn}J_{\varphi mn}\right)\right\}=0, \qquad (3)$$

$$Z_{mn}=\beta_n^2a^2I_m(\beta_na)K_m(\beta_na),$$

$$\Phi_{mn}=m^2\frac{h_n^2a^2}{\beta_n^2a^2}I_m(\beta_na)K_m(\beta_na)+k^2a^2I'_m(\beta_na)K'_m(\beta_na),$$

$$\Psi_{mn}=-mh_naI_m(\beta_na)K_m(\beta_na).$$

Card 3/4

26219
S/053/61/074/004/001/001
B102/B231

24,7700 (1144, 1163, 1143)

AUTHORS: Shestopalov, V. P. and Yatsuk, K. P.

TITLE: Methods of measuring the dielectric constants of materials at superhigh frequencies

PERIODICAL: Uspekhi fizicheskikh nauk, v. 74, no. 4, 1961, 721-755

TEXT: The present article summarizes the most frequently employed methods of s-h-f measurement of ε and tan δ. First, problems on the classification of these methods are dealt with. The following classification has been adopted in most publications: 1) methods using waves in the free space; 2) methods using directed waves; and 3) resonance methods. The method of directed waves, most frequently employed, is in its turn divided into subgroups: the twin-wire, waveguide, and coaxial-line methods: in the twin-wire line method, the following variants are distinguished: the first and the second method of Drude, the plate method of D. A. Rozhanskiy, and the method of V. V. Tatarinov. The other groups are subdivided similarly. From the general physical point of view of the interaction between field and matter, all the methods may be subdivided into the four

Card 1/4

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26219

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B102/B231

Methods of measuring the dielectric ...

main groups stated hereinafter: 1) methods basing on investigation of the field of stationary waves in the dielectric investigated; 2) methods basing on consideration of such waves as are reflected from the medium investigated; 3) methods basing on investigation of waves penetrating the medium; and 4) resonance methods. At last, attention is drawn to papers of N. A. Divil'kovskiy and M. I. Filippov, who determined $\mathcal{E}$ from the change in temperature occurring in a small dielectric sphere in the h-f field. In the following, the most important methods are described, first the methods using fast waves. 1) Investigation of the stationary wave field in the dielectric: $\mathcal{E}$ is determined from the well-known formula $\mathcal{E}=(\lambda_o/\lambda_{diel})^2$, and the loss angle from $\tan\delta = \frac{2}{\pi}\frac{E_{min}}{E_{max}}$. Moreover, the twin-wire line method of V. I. Kalinin and the coaxial-line method are briefly outlined. 2) Investigation of waves reflected from the dielectric. Subject of discussion is chiefly the short-circuit line method, followed by a description of its variants. Limiting cases, such as a dielectric without losses and another exhibiting high losses, are discussed in detail. Simple experimental arrangements used for measuring $\mathcal{E}$ and $\tan\delta$ by means of

Card 2/4

26219
S/053/61/074/004/001/001
Methods of measuring the dielectric ... B102/B231

reflected waves are described. 3) Methods for determining ε by means of penetrating waves: The simplest experimental arrangements for measuring ε and tan δ are described: 4) resonance methods permit the use of any transmission lines (twin-wire, coaxial, or waveguide). The methods differ in that the system is either completely or only partially filled with a dielectric. At frequencies $\gg 3 \cdot 10^9$ Mc, volume resonators are used for measuring ε, that is, two types of them: one type working on the basis of H_{011}-type waves, and the other working on the basis of E_{010}-type waves. Among other items, the semi-coaxial-type resonators of G. V. Zakhvatkin, which are used for measuring ε and tan δ, are described in detail. The next part of the work discusses methods basing on the use of slow waves. Waves whose phase velocity is less than c are to be filed among this class of waves. 1) Measurement of ε in solid dielectrics. a) The retarding spiral system is completely filled with a dielectric; b) determination of ε in case of a gap existing between the cylindrical dielectric and the spiral. 2) Measurement of ε in liquid dielectrics: a) The spiral is completely immersed in the dielectric; b) the liquid is contained in a tube. 3) ε-measurement by means of a spiral waveguide in a metal casing. 4) Determination of tan δ by the spiral-waveguide method;
Card 3/4

S/141/62/005/001/020/024
E039/E485

3.9600

AUTHORS: Shestopalov, V.P., Yakimenko, I.P., Fil', V.D.

TITLE: The propagation of unsymmetrical electromagnetic waves in a plasma column and their radiation

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v.5, no.1, 1962, 176-179

TEXT: The dispersion equation is derived for the propagation of unsymmetrical electromagnetic waves in a plasma column with a longitudinal magnetic field. The solution to this equation is presented graphically and shows the various regimes of propagation and cut off frequencies. The dispersion curves calculated from this dispersion equation are also shown graphically. The phase velocities of waves of different types depend strongly on the frequency, the plasma parameters and the longitudinal magnetic field. A normal and an anomalous dispersion is indicated. Approximate polar diagrams are calculated for dense plasmas in a magnetic field. These polar diagrams are symmetrical with respect to the axis. Numerical calculations made for waves with an index $n = 1$ show that the

Card 1/2

S/141/62/005/001/021/024
E039/E435

9.2571

AUTHORS: Shestopalov, V.P., Yakimenko, I.P., Prokhoy, V.V.

TITLE: Non-symmetrical electromagnetic waves in a spiral waveguide with longitudinally magnetized ferrites

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v.5, no.1, 1962, 179-183

TEXT: The dispersion equation is derived for this case and compared with the n-th propagation resonance. The form of the wave spectrum is shown graphically for two values of u where $u = w_H a/c$ (w_H is the gyrofrequency, a is the radius of the spiral), indicating the regions where slow and fast waves are propagated and also the regions of no propagation. Dispersion curves are obtained by graphical analysis before and after resonance for the case when the direction of wave propagation coincides with the direction of the magnetic field and also the converse of this. The direction of the magnetic field influences the phase velocity of the waves. The distribution of the flux density for various types of waves is calculated using the usual expression for flux density of monochromatic waves

Card 1/2

S/109/62/007/003/015/029
D266/D302

9,4230 (1...., 3304)

AUTHORS: ~~Shestopalov, V.P.~~, Slyusarskiy, V.A., and Kondrat'yev, B.V.

TITLE: Electron beam in a helix with anisotropic dielectric

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 3, 1962, 475 - 482

TEXT: The purpose of the paper is to study theoretically and experimentally the effect of an anisotropic dielectric on the properties of a helicoidal waveguide. The helix is surrounded by a dielectric whose permittivity components are denoted by ε_z, ε_r and ε_φ. Assuming an axially symmetric solution - and small signal conditions in the beam - the electric and magnetic intensities are obtained in the regions (i) $0 < r < a$, (ii) $a \leq r \leq b$ and (iii) $b \leq r \leq R$. The solutions are matched on the boundaries leading to a dispersion equation containing a large number of different Bessel functions. Plotting the right-hand side of the dispersion equation for several different geometries it is found that a function of the

Card 1/3

form

$$F(\beta) = C\,\frac{\beta - \beta'}{\beta - \beta''} \qquad (12)$$

gives a good approximation (β is the axial propagation coefficient and C, β', β'' are constants depending only on the geometry of the structure). Assuming furthermore that $\Gamma a \ll 1$ (i.e. the electric intensity is constant across the beam) the following simplified equation is obtained for β,

$$\left(1 - \frac{v_0}{c}\,\frac{\beta}{\beta_0}\right)^2 \left(1 - 20C\,\frac{\beta-\beta'}{\beta-\beta''}\right) - \frac{e}{m}\,\frac{j}{\epsilon_0 \pi a^2 v_0 \beta^2 c^2} = 0 \qquad (13)$$

where v_0 - beam velocity, c - velocity of light, j - beam current, $\beta_0 = \omega/v_0$, ω - frequency. It can be shown that (13) is equivalent to a third order equation in β, demonstrating that in the presence of the electron beam three waves propagate in the direction of the electron flow. Solving (13) for $\varepsilon_z/\varepsilon_r = 5$ and 0.5 the imaginary part of β is plotted against v_0/c. The gain is considerably higher

Electron beam in a helix with ... S/109/62/007/003/015/029
D266/D302

in the presence of the dielectric. For a given beam velocity, however, the available bandwidth is smaller. If $\varepsilon_z/\varepsilon_r$ is smaller the range of beam velocities resulting in amplification widens which is in agreement with the theoretical results of a previous paper of the authors (Ref. 1: ZhTF, 1959, 29, 9, 1317). The theory is confirmed by experiments on a waveguide. There are 7 figures, 1 table, and 8 references: 5 Soviet-bloc and 3 non-Soviet-bloc. The references to the English-language publications read as follows: L.J. Chu, D. Jackson, Proc. I.R.E., 1948, 36, 7, 859; B. Friedman, J. Appl. Phys., 1951, 22, 4, 443; W.J. Dodds, R.W. Peter, RCA Rev., 1953, 14 5, 502. X

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet im. A.M. Gor'kogo (Khar'kov State University im. A.M. Gor'kiy)

SUBMITTED: July 3, 1961

Card 3/3

S/109/62/007/003/026/029
D256/D302

AUTHORS: Shestopalov, V.P., Yakimenko, I.P., and Zdorovik, V.Ya.

TITLE: Electromagnetic wave radiation of a helix-ferrite antenna

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 3, 1962, 566 - 567

TEXT: Electromagnetic radiation and its dependence upon the magnetic field applied along the axis of the helix are considered using the Huyghens-Kirchhoff principle. General equations are set up using the initial conditions obtained by solving the problem of non-symmetrical wave propagation along an infinite helix wound round a ferrite rod to derive the fields and the phase velocities at the surface of the antenna. Directional diagrams of the antenna are presented, showing that with a change of the magnetic field the main maximum splits into two maxima symmetrical with respect to the axis. There are 2 figures and 4 Soviet-bloc references.

Card 1/2

40940

S/109/62/007/007/008/018
D266/D308

AUTHORS: Yakimenko, I. P. and Shestopalov, V. P.

TITLE: An experimental investigation of the helix-ferrite waveguide

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 7, 1962, 1115-1122

TEXT: Two configurations are studied: (1) ferrite cylinder inside the helix, (2) ferrite surrounding the helix. Helix and ferrite are in both cases placed in a coil producing homogeneous axial magnetic field. The voltage standing wave ratio (a function of frequency) was kept below the value 1.5. Since the phase velocity of the forward and backward propagating waves is different, the wavelength could not be determined from the measured standing wave ratio but was obtained by comparing the signal from a moving probe with that (through attenuators) from the signal generator. The measurements were performed at decimeter wave-lengths varying the magnetic field between 150 and 1000 oersted. The dielectric con-

Card 1/3

S/109/62/007/007/008/018
D266/D308

An experimental investigation ...

stant of the ferrite employed was $\varepsilon \cong 9$. The conclusions are as follows: If the helix is in the ferrite jacket the forward wave is more attenuated; if the ferrite is in the helix the attenuation is larger for the backward wave. This agrees with the corresponding conclusions of B. M. Bulgakov, V. P. Shestopalov, L. A. Shishkin and I. P. Yakimenko (*Radiotekhnika i elektronika, 1961, v. 6, no. 1, 81) and can be physically explained with the fact that the direction of rotation of the a.c. magnetic field (perpendicular to the d.c. magnetic field) depends on the relative position of helix and ferrite. If the ferrite is outside the helix, the elliptic polarization is negative (in accordance with earlier work), which makes the attenuation larger for the forward wave. The ratio of forward and backward attenuation can be influenced by the choice of the gap between helix and ferrite but the introduction of the gap increases the attenuation in both directions. The authors believe that filling the gap with dielectric can further improve the non-reciprocal character. Increasing the spacing between the turns, the absolute level of the losses decreases, which is due to the fact that the proportion of surface waves decreases. The phase

Card 2/3 * S/109/61/006/001/010/023

31953
S/057/62/032/001/016/018
B111/B102

24,7700 (1035, 1043, 1055)

AUTHORS: Yatsuk, K. P., and Shestopalov, V. P.

TITLE: Variant of the resonator method for a spiral waveguide for measuring the dielectric constants of a substance at superhigh frequencies

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 1, 1962, 119 - 126

TEXT: The advantage of the given method consists in that the arrangement of a dielectric on the resonator axis impairs its quality only slightly. The Maxwell equations were solved for an anisotropically conductive cylinder and an ideal isotropic dielectric. The resonator was divided into three sections (Fig.1), into the dielectric (diameter 2b) within the spiral, into the space between dielectric and spiral (diameter 2a), and into the space between spiral and surrounding cylindrical metal casing (diameter 2R) and the solutions for $\vec{E}$ and $\vec{H}$ were adapted to the boundary conditions.

Card 1/4

$$\varepsilon = \frac{2\Delta f}{f} \frac{\mu_1^b + \mu_0^b}{\mu_0^a - \mu_0^R - 2\frac{\Delta f}{f}\mu_0^b}, \qquad \mu_n^* = \frac{K_n\left(\frac{2\pi}{\lambda_g}x\right)}{I_n\left(\frac{2\pi}{\lambda_g}x\right)}; \qquad (9)$$

was derived for ε, I_n, K_n are the modified Bessel functions, λ_g is the wavelength of the lagging wave and Δf is the shift of the resonant frequency if a dielectric is introduced. $\tan\delta$ is calculated from $Q = \frac{\omega W}{P_s}$ and $\tan\delta = \sigma/\omega\varepsilon$ where Q is the quality factor, W the energy accumulated in the resonator, P_s is the power loss. For small samples a formula for $\tan\delta$ could be derived by substituting the field quantities in W and P_s. In this case W and P_s were assumed to be sums of the W_i and P_{si}, respectively, in the three sections of the resonator. The measurement of $\tan\delta$ with known ε and λ_g is thus reduced to the measurement of the resonator quality

31953
S/057/62/032/001/016/018
B111/B102

factor with and without dielectric

$$\tan\delta = \frac{1}{\varepsilon}\left(\frac{1}{Q_{\text{общ}}} - \frac{1}{Q'}\right)\frac{2a}{k_3 b^2}\left(G + M^2\frac{q_{01}^{aR}}{q_{00}^{aR}}\right). \qquad (16)$$

$$M = I_0(k_3 a) - \frac{(k_3 b)^2}{2}(1-\varepsilon)\, q_{00}. \qquad (A)$$

$$\left.\begin{aligned} &A_2 = A\left[1 + \frac{1}{2}k_3^2 b^2 (1-\varepsilon)\ln\frac{k_3 b}{2}\right];\quad B_2 = \frac{1}{2}A(k_3 b)^2(1-\varepsilon),\\ &a\Phi_1(a) = aA^2 G,\\ &G = \left\{I_0(k_3 a) + \frac{1}{2}(k_3 b)^2(1-\varepsilon)\left[I_0(k_3 a)\ln\frac{k_3 b}{2} + K_0(k_3 a)\right]\right\}[I_1(k_3 a) + \\ &\quad + \left(\frac{k_3 b}{2}\right)^2(1-\varepsilon)\left[I_1(k_3 a)\ln\frac{k_3 b}{2} - K_1(k_3 a)\right]\Big\},\\ &b\Phi_1(b) = bA^2\left\{1 + \frac{1}{2}(k_3 b)^2\left[\frac{1}{2}\ln k_3 b - \ln\frac{k_3 b}{2}\right)\right\}\left\{\frac{1}{2}k_3 b + \right.\\ &\quad + \frac{1}{2}(k_3 b)^2(1-\varepsilon)\left[\frac{1}{2}k_3 b\ln\frac{k_3 b}{2} - \frac{k_3 b}{2}\right]\Big\}. \end{aligned}\right\} \qquad (11a)$$

37055
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B125/B108

9,3700

AUTHORS: Agranovich, Z. S., Marchenko, V. A., and Shestopalov, V. P.

TITLE: Diffraction of electromagnetic waves on plane metal gratings

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 4, 1962, 381-394

TEXT: The authors have calculated the diffraction of a plane polarized electromagnetic wave incident perpendicularly upon a periodic grating parallel to the x-axis in the XOY plane (E_y, E_z, H_y, H_z = 0). l is the grating constant, d is the gap width. The metal is a perfect conductor. The two special cases of E polarization ($\vec{E}_0 \parallel OX$) and H polarization ($\vec{H}_0 \parallel OX$) can be calculated similarly. The sought electrical field is

$$E_x = e^{-ikz} + \sum_{n=-\infty}^{\infty} a_n e^{i\sqrt{k^2-\left(\frac{2\pi n}{l}\right)^2}\, z} e^{\frac{2\pi i n}{l} y} \quad (z>0), \tag{3}$$

above the grating (superposition of the incident and reflected fields) and

$$E_x = \sum_{n=-\infty}^{\infty} b_n e^{-i\sqrt{k^2-\left(\frac{2\pi n}{l}\right)^2}\, z} e^{\frac{2\pi i n}{l} y} \quad (z<0), \tag{3'}$$

Card 1/5

the infinite set of equations

$$\left.\begin{aligned} x_m &= i\varkappa b_0 V_m^0 - i\varkappa V_m^0 + \sum_{n\neq 0} x_n \frac{|n|}{n}\varepsilon_n V_m^n + 2cR_m \quad (m\neq 0),\\ 0 &= i\varkappa b_0 V_0^0 - i\varkappa V_0^0 + \sum_{n\neq 0} x_n \frac{|n|}{n}\varepsilon_n V_0^n + 2cR_0,\\ -b_0 &= i\varkappa b_0 V_{[\sigma]}^0 - i\varkappa V_{[\sigma]}^0 + \sum_{n\neq 0} x_n \frac{|n|}{n}\varepsilon_n V_{[\sigma]}^n + 2cR_{[\sigma]}, \end{aligned}\right\} \quad (19)$$

$$x_n = b_n n.$$

for determining b_0, x_m, and b_m, where $x_n = b_n n$. (19) can be solved numerically e.g. by successive approximation if ε is sufficiently small. The authors consider the case in which $0 < \varkappa < 3$ (so that $\varepsilon_{\pm 1}$, $\varepsilon_{\pm 2}$, $\varepsilon_{\pm 3}$ are of the order of unity). In this case, the longwave approximation does not hold any longer, the shortwave one does not yet. (19) gives with $\varepsilon_n = 0$ at every $|n| > N$ a finite set of equations:

Card 3/5

S/057/62/032/004/001/017
B125/B108

Diffraction of electromagnetic ...

language publication reads as follows: G. L. Baldwin, A. E. Heins, Math. scand., 2, no. 1, 103, 1954.

ASSOCIATION: Fiziko-tekhnicheskiy institut nizkikh temperatur AN USSR (Physicotechnical Institute of Low Temperatures AS UkrSSR) Khar'kovskiy gosudarstvennyy universitet im. A. M. Gor'kogo (Khar'kov State University imeni A. M. Gor'kiy)

SUBMITTED: April 14, 1961

Card 5/5

S/057/62/032/009/011/014
B117/B186

AUTHORS: Yatsuk, K. P., Shestopalov, V. P., and Lyashchenko, V. A.

TITLE: Limits of applicability of the method of a helical waveguide for the measurement of dielectric constants in matter

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 9, 1962, 1102 - 1103

TEXT: It was shown from several measurements on specimens having known dielectric constants that the results of measuring ε of a VHF material under investigation depend on the geometry of the helix and specimen as well as on the frequency range used. In order to elucidate this influence and the limits of applicability for the formulas previously derived (V. P. Shestopalov, K. P. Yatsuk. ZhTF, XXIX, 7, 819, 1959; ZhTF, XXIX, 9, 1090, 1959), dispersion properties of the systems helix-dielectric and helix-laminated dielectric (liquid in a tube) were investigated by comparison of calculated and experimental dispersion curves. Conclusions: The calculated and experimental curves, observed in a certain frequency range, are in agreement if the ratio between the diameter of the specimen, 2a, and the length λ_g of the retarded wave is greater than unity. This confirms that

Card 1/3

Limits of applicability of the... S/057/62/032/009/011/014
B117/B186

SUBMITTED: June 17, 1961 (initially)
January 11, 1962 (after revision)

Card 3/3

APPROVED FOR RELEASE: 07/13/2001 CIA-RDP86-00513R001549130006-2"

L 8597-65 EWT(1)/EEC-4/EWA(h) RAEM(a)/RAEM(t) S/0058/63/000/011/H036/H036

ACCESSION NR: AR4044069

SOURCE: Ref. zh. Fizika, Abs. 11Zh282 B

AUTHOR: Yatsuk, K. P.; Shestopalov, V. P.; Lyashchenko, V. A.

TITLE: The limits of applicability of the helical waveguide method for measuring the permittivities of a substance 25

CITED SOURCE: Uch. zap. Khar'kovsk. un-t, v. 132, 1962, Tr. Radiofiz. fak., v. 7, 168-172

TOPIC TAGS: helical waveguide, permittivity, liquid dielectric, wavelength

TRANSLATION: It is shown that the accuracy in determining the permittivity ε by the helical waveguide method depends essentially on the geometry of the spiral and the sample. On the basis of conducted experimental studies it is established that when $D/\lambda_g<1$ (D is the diameter of the solid sample, λ_g is the length of the attenuated wave) the value of ε differs sharply from its true value. There are given the limits of D/λ_g, for which ε is determined with the required accuracy. The fact

Card 1/2

L 8597-65

ACCESSION NR: AR4044069

that these assertions are correct is strengthened by experimental data. For the case of liquid dielectrics in a tube, the working range of the wavelengths in which ε can be determined increases with increasing ε of the tube; when ε of the tube is greater than that of the dielectric, the value $0.7 \le D/\lambda_g \le 1.5$, with an error of the order of 10-15% in determination of ε. Gives the results of an experimental determination of ε for liquids in this range.

SUB CODE: EC, EM ENCL: 00

Card 2/2

L 10136-63 BDS/EWT(1)/FCS(k)/EEC-2/EED-2--AFGC/ASD/ESD-3--Pi-4/Pj-4/
Pi-4--WR

ACCESSION NR: AP3000159 S/0141/63/006/002/0353/0363
73
72

AUTHOR: Tret'yakov, O. A.; Shestopalov, V. P.

TITLE: Electromagnetic-wave diffraction at a flat metal array supported by a dielectric layer
25B

SOURCE: Izvestiya vysshikh uchebnykh zavedeniy, radiofizika, v. 6, no. 2, 1963, 353-363

TOPIC TAGS: electromagnetic-wave diffraction, metal array

ABSTRACT: Metal-strip arrays for filters, polarizers, artificial dielectrics, etc., have been materialized either as rigid ribbons of a definite thickness or as thin coatings on a dielectric plate. Design formulae are usually based on an infinitely thin array in space. The article investigates mathematically the effect of an isotropic dielectric supporting plate on the diffraction characteristics of such an array. The diffraction field is found for arbitrary wavelength, strip width, dielectric thickness, and array pitch by the method developed by Z. S. Agranovich, et al. (ZhTF, 32,382, 1962). Approximate formulae for reflection and transmission coefficients are given, as well as the results of computations that used these formulae.

Card 1/2

Khar'kov State University

~~L 10135-63~~ BDS/EWT(1)/FCS(k)/EEC-2/EED-2--APGC/ASD/ESD-3--Pi-4/Pj-4
~~Pi-4--WR~~

ACCESSION NR: AP3000160 S/0141/63/006/002/0364/0372

74
72

AUTHOR: Tret'yakov, O. A.; Khoroshun, D. V.; Shestopalov, V. P.

TITLE: Electromagnetic-wave diffraction at a planar shielded array (normal incidence case)

25B

SOURCE: Izvestiya vysshikh uchebnykh zavedeniy, radiofizika, v. 6, no. 2, 1963, 364-372

TOPIC TAGS: electromagnetic-wave diffraction, shielded metal array

ABSTRACT: The mathematical method suggested by Z. S. Agranovich, et al. (ZhTF, 32, 382, 1962) is used to solve the problem of diffraction of a planar electromagnetic wave normally incident upon a shielded dielectric-filled array. The flat-strip array is parallel to a perfectly-conducting plane, and the space between them is filled with an isotropic dielectric having an arbitrary permittivity. Arbitrary relations between the wavelength, array pitch and strip width are considered. The above structure is important in examining the double-mirror antenna arrays and also in investigating the propagation of

Card 1/2

L 10135-63
ACCESSION NR: AP3000160

electromagnetic waves in ring-type and helical waveguides that operate in a dielectric medium. Orig. art. has: 17 equations and 6 figures.

ASSOCIATION: Khar'kovskiy gosudarstvenny*y universitet (Khar'kov State University)

SUBMITTED: 30Jun62 DATE ACQ: 12Jun63 ENCL: 00

SUB CODE: SD NR REF SOV: 003 OTHER: 000

Card rh/dfe 2/2

APPROVED FOR RELEASE: 07/13/2001 CIA-RDP86-00513R001549130006-2"

L 10000-63 EWT(1)/BDS/EEC(b)-2--AFFTC/ASD/ESD-3--IJP(C)

ACCESSION NR: AP3000991 S/0109/63/008/006/0950/0958

58

AUTHOR: Adonina, A. I.; Shestopalov, V. P.

57

TITLE: Diffraction of electromagnetic waves in a plane metal grid with screen (case of arbitrary incidence)

SOURCE: Radiotekhnika i elektronika, v. 8, no. 6, 1963, 950-958

TOPIC TAGS: EM wave diffraction, diffraction in a grid

ABSTRACT: An analysis is given of the diffraction of EM waves which pass through an infinitely thin, perfectly conducting metallic grid and impinge on an adjacent parallel metal screen. With the assumption that wave polarization and angle of incidence are arbitrary, equations are derived which define the resultant E and H fields in the grid apertures as well as in the metal elements of grid and screen. The dimensional variables are grid aperture, grid wire width, and spacing between grid and screen, all expressed as ratios of incident wave length. By way of illustration, the particular case is considered where the E vector is parallel to the grid wires and the problem reduces to the simultaneous

Card 1/2

L 10000-63
ACCESSION NR: AP3000991

solution of eight equations. Graphical results are given for this solution, showing the reflection factor as a function of the above dimensions and of angle of incidence; on consideration of the diffraction spectrum, it is seen that the reflection factor increases generally with angle of incidence for the fundamental, but decreases with the angle at harmonic frequencies. It is noted that with sufficiently remote spacing of the parallel screen from the grid the problem reduces to one involving the grid alone -- a case already analyzed by Agranovich, Marchenko, and Shestopalov (ZhTF, 1962, 32, 4, 381). Orig. art. has: 5 figures and 19 formulas.

ASSOCIATION: Khar'kovskiy gosudarstvenny*y universitet im. A. M. Gor'kogo (Khar'kov State University)

SUBMITTED: 04Jun62 DATE ACQ: 01Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 002 OTHER: 000

bm/kl
Card 2/2

TRET'YAKOV, O.A.; SHESTOPALOV, V.P.

Controlling the radiation from a plane-parallel layer by means of gratings. Opt. i spektr. 15 no.5:709-712 N '63. (MIRA 16:12)

L 12907-63 EWT(1)/BDS/EEC-2/EED-2 AFFTC/ASD/ESD-3/APGC Pj-4/Pk-4/Pl-4/
Pm-4 IJP(C)/WR
ACCESSION NR: AP3001322 S/0057/63/033/006/0641/0651 79 78

AUTHOR: Adonina, A. I.; Shestopalov, V. P.

TITLE: Diffraction of electromagnetic waves obliquely incident on a plane metallic grating backed by a dielectric layer

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 33, no. 6, 1963, 641-651

TOPIC TAGS: diffraction, gratings, transmission

ABSTRACT: The problem of the diffraction of plane electromagnetic waves obliquely incident on a thin infinite plane metallic grating backed by a dielectric layer of finite thickness is solved for the case in which the plane of incidence is normal to the rulings. Several curves are given showing the transmission coefficient for the directly transmitted beam as a function of wavelength for a number of angles of incidence and values of the ratio of metal to open space in the grating. The curves all refer to the case in which there is no dielectric backing. The points at which spectra of successive orders first appear are marked on these curves by peaks or changes of slope. From these curves and others not published, the authors draw the following conclusions concerning the transmission coefficient for the directly transmitted beam: 1) The transmission coefficient decreases with increasing angle

Card 1/2